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EFFECT OF CARBON DIOXIDE, CARBONIC OXIDE, SULPHURETED HYDROGEN AND WATER AND COAL GAS ON ANIMAL LIFE.[1]

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Since the health of every individual is dependent upon the purity of the atmosphere, a knowledge of the effect of impurities in the air on animal life is of the highest importance to the community at large, but of special importance to those who work in coal, silver, lead, copper or gold mines, or at iron furnaces, coke ovens, etc., where impurities often exist, such as,

		S. D.
CO_2	Choke damp or Carbon Dioxide, ...	1·529
CO	White damp or Carbonic Oxide, ...	·9678
H_2S	Sulphureted Hydrogen or Hydrogen Sulphide, ...	·1912

The statistics compiled by me from the Indices of the Library of the College of Physicians, Philadelphia, one of the most complete institutions in the world, show that 90 per cent. of the total scientific experiments on the effects of noxious gases on animal life have been made by the Germans and French, and for the last decade scarcely any experiments have been made in this direction by scientists of any nationality, the results obtained by our forefathers being accepted with a credulity seldom encountered in other branches of science. In addition to this, the poverty of information in the standard references on this subject is so great, that were any particular knowledge required, it would be necessary to make new experiments to determine the same. With these facts before

[1] Lecture delivered before the Philadelphia College of Pharmacy, November 21, 1893.

me, in grouping the results obtained in experiments with Carbon Dioxide, Carbonic Oxide and Sulphureted Hydrogen on animal life, the medical fraternity will at least have a condensation of experiments for reference, from many authorities combined with the results of my own experiments. I claim that my experiments are absolutely accurate, as the means employed for mixing the different atmospheres (the Shaw Gas Tester) is acknowledged to be as nearly perfect as human agency can make anything, and has been awarded the Elliott Cresson and Scott Legacy Medals for accuracy—the highest awards in the gift of the Franklin Institute, and is to gases what weights and scales are to solids.

It is not my intention to go into the constituents of the above gases, there being no necessity for my doing so in this paper. I have simply one object in view, to describe the effect produced by them on animal life, the result of recent experiments. The Shaw Gas Tester, which I used for mixing my gases in the centesimal proportions desired, is an apparatus simple, convenient and accurate, consisting of 2 pumps with pistons attached to a graduated arm, so that one cylinder can be set to pump 10 per cent. of gas and the other 90 per cent. of air—or vice versa; or any per cent. to the lowest fraction. It is the only instrument in the world capable of mixing gases accurately, rapidly, and continuously in any per cent. desired, the product of the two cylinders being forced through an ejector or mixer before delivery.

The animal under treatment is placed in a bell-shaped glass cylinder 16 inches high, 4 inches diameter at neck and 8 inches at base. The cylinder is placed horizontally on the table, with the neck towards the operator, and is connected with the instrument, at the neck, by means of a rubber tube. The animal rests on all fours facing the operator with its nose near the aperture through which the gases enter to the cylinder from the instrument or mixer.

The end of the bell-shaped glass cylinder is entirely open to the air so that the mixture of gas and air is discharged and replaced every 4 seconds by each stroke of the pump, always maintaining a constant mixture, preventing stratification, or contamination through the exhalations of the subject. The cylinder being of glass and perfectly transparent, enables the operator to observe every change in the condition of the animal.

The difference in results obtained by the various authorities has

caused me to make the following experiments to satisfy myself, an accurate knowledge on this subject being necessary to the pursuit of my profession, and I am well aware of the great difficulties experienced by my predecessors in making accurate mixtures of gases, owing to the crude appliances at their command for this purpose.

As a prelude to my experiments I will give the results obtained with carbon dioxide by scientists whom we are accustomed to quote:

CARBON DIOXIDE.

J. H. Merrivale says it extinguishes lights and is fatal to animal life.

	Per Cent.
J. J. Atkinson says dangerous to life,	8
lights extinguished,	10
Fairley's Catechism—dangerous to life,	3
will cause death quickly,	10
lights will burn in,	10 to 20
Sir H. Roscoes' Chemistry—will not support combustion of candle,	3 to 6
Dr. A. Smith—lights extinguished, about	2
would suffocate,	4

Watts' Dictionary of Chemistry says: "Animals immersed in it soon die, not for want of oxygen, but in consequence of a direct poisonous action, violent spasms being sometimes produced; sometimes complete atony of the cerebral faculties."

Ency. Brit., Vol. 5, p. 87, says: "Will not burn; neither does it support combustion."

Dr. Karl Friedlander, of Berlin, in experiments on animal life, states that 62·8 per cent. killed a rabbit in 27 minutes; 65 per cent. killed a rabbit in 45 minutes, the higher per cent. in this instance taking longer to kill the rabbit than the lower per cent., showing a wide variation in his tests, which I can only account for in the imperfect appliances at his command for placing definite quantities of gas in the atmosphere and maintaining a constant mixture of definite proportions. Rabbits, like human beings, have their ailments, and I have found in the course of my experiments that disease in the shape of a fatty accumulation about the heart, disqualifies the animal entirely for tests of this nature, death resulting in one-tenth of the time necessary to produce the same result on a perfectly healthy animal, but in the above instance the difference in time of immersion in such a high per cent. is not great enough for me to

ascribe the difference in effect to any organic disease but rather to the imperfect mixing of the gases.

In all my experiments I have found that the smaller the animal the sooner it succumbed to poisonous gases. My first experiments were made with small birds, then I tried mice, after which I bestowed my attention on guinea pigs, finally selecting the rabbit as a base for the experiments which I now present.

EFFECTS OF CARBON DIOXIDE ON ANIMAL LIFE.

No. 1. I placed a rabbit in a glass cylinder and pumped in atmosphere of 10 per cent. of CO_2 and 90 per cent. of air.

After one hour and seven minutes the rabbit gave no indication whatever of being affected, so I released it and allowed it to run with several other of its species, the effect of its treatment, contrary to expectation, was great exhilaration, instead of stupefaction.

RESULT.—10 per cent. CO_2 and 90 per cent. air, 1 h. 7 m. inhalation; exhilaration.

No. 2. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 25 per cent. of CO_2 and 75 per cent. of air for one hour, at the end of which time the animal showed no indication whatever of being affected and when released and placed with the others exhibited as much liveliness as any of them.

RESULT.—25 per cent. CO_2 and 75 per cent. air, 1 h. inhalation; unaffected.

No. 3. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 50 per cent. of CO_2 and 50 per cent. of air. At the end of two minutes the rabbit showed signs of being affected. At the end of three minutes the rabbit commenced to gasp regularly every two seconds.

At the end of	6	minutes	gasps were	3	seconds apart.
"	10	"	"	4	"
"	12	"	"	6	"
"	14	"	"	8	"
"	15	"	"	9	"
"	16	"	"	10	"
"	17	"	death ensued.		

RESULT.—50 per cent. CO_2 and 50 per cent. air, 17 minutes inhalation; death.

No. 4. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 75 per cent. of CO_2 and 25 per cent. of air.

At the end of 2 minutes rabbit commenced to pant rapidly.
" 3 " it became stupefied and gasped every 2 seconds.
" 5 " gasps were every 3 seconds apart.
" 7 " " 5 "
" 8 " " 6 "
" 9 " " 10 "
" 10 " death ensued.

RESULT.—75 per cent. CO_2 and 25 per cent. air, 10 minutes inhalation; death.

No. 5. I placed a mouse in a glass cylinder and pumped in an atmosphere of pure CO_2; death was instantaneous.

RESULT.—Pure CO_2; death instantaneous (mouse).

No. 6. I placed a mouse in a glass cylinder and pumped in an atmosphere of 25 per cent. CO_2 and 75 per cent. air. At end of 3 minutes mouse seemed slightly affected but kept moving around the cylinder, in this test held vertically. At the end of ten minutes conditions were unchanged, so I displaced the atmosphere of 25 per cent. CO_2 with pure air.

RESULT.—The mouse revived, instantaneously on first inhalation.

RESULT.—25 per cent. CO_2 and 75 per cent. air, 10 minutes inhalation, slightly affected but recovered instantaneously in fresh air (mouse).

No. 7. I Placed a mouse in a glass cylinder and pumped in an atmosphere of 50 per cent. of CO_2 and 50 per cent. air.

At the end of 10 seconds mouse showed great exhilaration.
" 20 " its activity was greatly reduced.
" 30 " it became stupefied.
" 35 " gave short gasps.
" 45 " gasps were long and apparently painful.
" 55 " death occurred.

RESULT.—50 per cent. CO_2 and 50 per cent. air, 55 seconds inhalation; death (mouse).

Experiments 5, 6 and 7 are only given here to illustrate the fact that the smaller the animal the less the power of resistance against CO_2.

CARBONIC OXIDE, CO.

The results obtained by scientists whom we are accustomed to quote, on the effect of Carbonic Oxide on animal life, are first epitomized:

H. Letheby, M.B.,M.A.,Ph.D., etc., late Professor of Chemistry and Toxicology in the Medical College of the London Hospital, says

that 5 per cent. of CO killed small birds in 3 minutes; one per cent. in half that time; 2 per cent. will render guinea pigs insensible in 2 minutes. In all cases effects were the same. The animals show no signs of pain, they fall insensible, and either die at once with a slight flutter, hardly amounting to a convulsion, or gradually sleep away as if in profound slumber.

Post-Mortem—Blood a little redder than usual.

Prof. A. R. Leeds says: "The operation of pure CO is so immediate as to prevent the lungs throwing off a single charge received."

Watts Dictionary of Chemistry says: "It is a very poisonous gas, acting chiefly on the nervous system, causing giddiness when inhaled; sometimes acute pain in various parts of the body and after awhile complete asphyxia."

Buck, on Hygiene and Public Health says: "It is not so immediately fatal as Carbonic Acid Gas."

Ency. Brit., Vol. 5, p. 87, says: "It is an extremely poisonous gas, being capable of displacing the oxygen in the blood, owing to a compound with the hæmoglobin, with which the oxygen is ordinarily combined."

American Ency., vol. 3, p. 775, says: "It is more irrespirable and poisonous than Carbon Dioxide. Its inhalation from furnaces sometimes causes immediate asphyxia to the workmen."

I will now submit results of my own experiments on the effect of Carbonic Oxide on animal life, but have to omit several important tests, owing to the carelessness of a servant in destroying my notes.

No. 1. I Placed a rabbit in a glass cylinder and pumped in an atmosphere of 2 per cent. of CO and 98 per cent. of air. At the end of 10 minutes the posterior extremity of the rabbit became paralyzed; at the end of 18 minutes forelegs became paralyzed, and at the end of 20 minutes the rabbit became semi-comatose; at the end of 45 minutes condition had not altered; on being placed in the fresh air it revived sufficiently to maintain its equilibrium.

RESULT.—2 per cent. CO and 98 per cent. air, revived in fresh air after 45 minutes inhalation of the gas.

No. 2. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 2·5 per cent. of CO and 97·5 per cent. air. At the end of 5 minutes the rabbit became semi-comatose, but on being placed in pure air, recovered almost immediately.

RESULT.—2·5 per cent. CO and 97·5 per cent. air, revived in fresh air after 5 minutes inhalation of the gas.

No. 3. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 4 per cent. of CO and 96 per cent. of air. Death resulted in 4½ minutes.

RESULT.—4 per cent. CO and 96 per cent. air, 4½ minutes inhalation; death.

No. 4. I placed a mouse in a glass cylinder and pumped in an atmosphere of ·2 of 1 per cent. of CO. At the end of 6 minutes the mouse showed no signs whatever of being affected.

No. 5. Increased the atmosphere to ·5 of 1 per cent. of CO. At the end of 5 minutes, the mouse showed no signs whatever of being affected.

No. 6. Increased the atmosphere to 1·0 per cent. of CO. At the end of 30 minutes, the mouse showed no signs of being affected. Gave it then fresh air to revive it for 1 minute. Increased atmosphere to 2·0 per cent. CO. Mouse died in 10 minutes; death accompanied with a total relaxation of all the muscles.

RESULT.—2 per cent. CO and 98 per cent. air, 10 minutes inhalation; death (mouse).

No. 7. I placed a mouse in an atmosphere of 2·5 per cent. of CO and 97·5 per cent. air; mouse died in 5 minutes.

RESULT.—2·5 per cent. CO and 97·5 per cent. air, 5 minutes inhalation: death (mouse).

No. 8. I placed a mouse in an atmosphere of 10 per cent. of CO, 90 per cent. air; death resulted in 3 minutes.

RESULT.—10 per cent. CO and 90 per cent. air, 3 minutes inhalation; death (mouse).

In the absence of the missing tests, I have included experiments 4, 5, 6, 7 and 8, simply to illustrate the fact that the smaller the animal the less the power of resistance against CO.

SULPHURETED HYDROGEN.

I note again the results obtained by scientific authorities whom we are accustomed to quote, on the effect of *Sulphureted Hydrogen* on animal life:

Watts' Dictionary of Chemistry, p. 203, says: "An atmosphere of one-tenth of 1 per cent. of this gas, proves fatal to lower animals."

Extract from Public Health Reports and Papers, Vol. III, p. 75,

76, says: "It is poisonous and its action on arterial blood is a common lecture table experiment."

Ency. Brit., Chemistry, Vol V, p. 500, says: "It cannot be breathed with impunity, frequently giving rise to nausea and vertigo, even when much diluted."

American Ency., Vol. IX, p. 130, says: "Theuard found that a small bird would die in air containing fifteen one-hundredths of 1 per cent., and a horse in air that contained ¼ of 1 per cent."

The results of my experiments on the effect of H_2S on animal life are as follows:

No. 1.

1. I placed a rabbit in a glass cylinder and pumped in an atmospere of 1 per cent. of H_2S and 99 per cent. of air.

2. I placed another rabbit, in another glass cylinder and pumped in an atmosphere of 1 per cent. of H_2S, and 99 per cent. of air simultaneously with the No. 1, using two Shaw Gas Testers as mixers for the operation, both connected with the same bag of H_2S.

Death occurred simultaneously in cylinders Nos. 1 and 2, at the end of one minute, preceded by violent convulsions which lasted about 10 seconds.

RESULT.—1 per cent. H_2S and 99 per cent. of air, 1 minute inhalation; death.

No. 2.

1. I placed a rabbit in glass cylinder No. 1, and pumped an atmosphere of ·5 of 1 per cent. of H_2S and 99·5 per cent. of air.

2. I placed another rabbit in glass cylinder No. 2, and pumped in an atmosphere of ·5 of 1 per cent. of H_2S and 99·5 per cent. of air, simultaneously with No. 1, using 2 Shaw Gas Testers as mixers for the operation, both connected with the same bag of H_2S. Death occurred simultaneously in cylinders 1 and 2, at the end of three minutes, preceded by violent convulsions which lasted about 15 seconds.

RESULT.—·5 of 1 per cent. H_2S and 99·5 per cent. air, 3 minutes inhalation; death.

No. 3.

1. I placed a rabbit in glass cylinder No. 1, and pumped in an atmosphere of ·2 of 1 per cent. of H_2S, and 99·8 per cent. of air.

2. I placed another rabbit in glass cylinder No. 2, and pumped in

an atmosphere of ·2 of 1 per cent. of H_2S, and 99·8 per cent. of air, simultaneously with No. 1, using two Shaw Gas Testers, as mixers for the operation, both connected with the same bag of H_2S. Death resulted simultaneously in cylinders Nos. 1 and 2 at the end of 10 minutes.

RESULT.—·2 of 1 per cent. H_2S, and 99·8 per cent. air, 10 minutes inhalation; death.

No. 4. I placed a rabbit in a glass cylinder and pumped in an atmosphere of one-tenth of 1 per cent. of H_2S, or the $\frac{1}{1000}$ part and 999 per cent. of air. Death resulted in 37 minutes.

RESULT.—·1 of 1 per cent. H_2S or the $\frac{1}{1000}$ part, and 999 per cent. of air, 37 minutes inhalation; death.

NOTE.—In all of the above tests rabbits were seized with convulsions 10 to 15 seconds after immersion in poisonous atmosphere, which lasted on an average about 12 seconds.

No. 5. I placed a rabbit in a glass cylinder and pumped in an atmosphere of $\frac{25}{1000}$ of 1 per cent. of H_2S, and 99 and $\frac{975}{1000}$ per cent. of air. At the end of 2 hours, rabbit showed no signs whatever of being affected, so I released it.

RESULT.—$\frac{25}{1000}$ of 1 per cent. of H_2S, and 99 and $\frac{975}{1000}$ of air, after two hours inhalation; unaffected.

EFFECT OF ILLUMINATING OR COAL AND WATER GAS ON ANIMAL LIFE.

The frequent occurrence of accidental deaths from illuminating gas has caused me to make a series of experiments on this subject with a view to determining just how much risk we run in having a small escape of gas in our bed-rooms, for instance, and the results obtained ought to act as a warning to all who are anyway careless in turning off the stop-cocks before retiring, or who carelessly turn the gas low near a draft and find it blown out the next morning and the room filled with gas.

No. 1. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 75 per cent. of illuminating gas (water and coal gas) and 25 per cent. of air. Rabbit was immediately seized with violent convulsions and death ensued in 2 minutes.

RESULT.—75 per cent. illuminating (water and coal gas) and 25 per cent. air, 2 minutes inhalation; death.

No. 2. I placed a rabbit in a glass cylinder and pumped in 25 per cent. of illuminating gas (water and coal gas) and 75 per cent. air; on

the third inhalation the rabbit was seized with violent convulsions and urinated freely; at the end of one minute convulsions ceased, and at the end of 4 minutes death ensued.

RESULT.—25 per cent. illuminating gas (water and coal gas) and 75 per cent. air, 4 minutes inhalation; death.

No. 3. I placed a rabbit in a glass cylinder and pumped in 15 per cent. of illuminating gas (water and coal gas) and 85 per cent. of air; without any struggling it sank into a comatose state; at the end of 3 minutes it struggled feebly; at the end of 4 minutes urinated; and at the end of 6 minutes death ensued.

RESULT.—15 per cent. illuminating gas (water and coal gas) and 85 per cent. of air; 6 minutes inhalation; death.

No. 4. I placed a rabbit in a glass cylinder and pumped in 10 per cent. of illuminating (water and coal) gas and 90 per cent. of air; at the end of 13 minutes rabbit was seized with convulsions and died in 5 seconds.

RESULT.—10 per cent. illuminating (water and coal) gas and 90 per cent. air; 13 minutes inhalation; death.

No. 5. I placed a rabbit in a glass cylinder and pumped in an atmosphere of 5 per cent. of illuminating (water and coal) gas and 95 per cent. of air. At the end of 10 minutes rabbit was seized with strong convulsions which lasted 20 seconds, at the end of 20 minutes rabbit commenced to gasp; and at the end of 30 minutes death ensued.

RESULT.—5 per cent. illuminating (water and coal) gas and 95 per cent. of air; 30 minutes inhalation; death.

I did not analyze the illuminating gas for its constituents but the gas used was Philadelphia city gas, and I believe it contains about 30 per cent. CO.

I have other experiments on hand on CH_4 carburetted hydrogen or fire damp, also the effect of carbon dioxide or choke damp on lights, the results of which it will afford me pleasure to make known in my next paper.

A TALK ON VANILLAS.

By Charles E. Hires.

Read at a Pharmaceutical Meeting of the Philadelphia College of Pharmacy, Nov. 21.

The importance of Vanilla Bean and consequently the value of the subject of which I am about to speak cannot be more correctly estimated than by a brief glance at its importance and value as a factor in the commercial products of this country.

To the majority of men the use of Vanilla Bean is limited to a flavoring extract for ice cream, or to add a delicacy and piquancy to an after-dinner dessert; but to the specialist, familiar with its use, it assumes a magnitude that is really astonishing. In the year of 1892, in this country alone there was imported and consumed in the various industries and agencies requiring vanilla over one million dollars worth of this product, numbering over fifteen million beans, and employing in the operation of raising, picking, curing, packing and shipping over 35,000 people, constituting in value, in commercial importance, in capital involved, in its production and in the amount of labor required for its development, one of the most important products of this vast and rich country.

The vanilla bean is indigenous to the soil of Mexico. The chief centre of its cultivation is the state of Vera Cruz, and the metropolis of the Vanilla district is the city of Papantla. After twenty years of active experience in handling Vanilla, after a long and careful study of it as an article of commerce, and an intimate acquaintance of its various uses, and its growing value as an article of import, I became possessed with a desire to see it in its natural state, to ride beneath the forests where it grew, to pluck it by my own hands from its natural branch; to enjoy its sweet and delicious aroma in the land of its birth, and in general to familiarize myself with the growth and preparation of this wonderful product, which is so rapidly growing in favor as one of our 19th century luxuries.

Take down your map of Mexico and locate the city of Vera Cruz, in the state of Vera Cruz, situated on the western shore of the Bay of Campeche. Go north from Vera Cruz a distance of some three hundred miles to Tuxpan. Equip yourself there with a retinue of mustangs, servants, guide and interpreter, and start to the southwest on a three days' journey, over mountains, through impenetrable forests, over dangerous and treacherous morasses, and

through tropical jungles to the city of Papantla, situated about seventy-five miles from the coast, inaccessible by railroad or water, and in the heart of a wild and as lawless a country as you would care to visit, and you have reached the heart of the Vanilla growing district; only a few hundred miles by actual measurement, but requiring more time, toil, privation and danger than to make a trip to the Orient. The journey southward was one to me of absorbing interest and constant danger. Its strange inhabitants, its peculiar customs, its striking scenery, and its topographical and geographical features were so impressed upon me by my journey, that I know my audience will pardon a brief and hurried description of some of its most salient features as we pass on our southern march to the home of the Vanilla Bean.

Actuated by the desire before mentioned I left Philadelphia on the 31st of January of this year, on a bright, clear, cool, but pleasant Monday. Next day in the state of Indiana we struck a blizzard with the thermometer down to zero; reaching St. Louis we encountered the worst snow storm of the season with the thermometer below zero, and the cars impossible to keep warm. Leaving St. Louis at eight o'clock in the evening we journeyed southward, and the next morning found ourselves with the thermometer 55° above zero with a bright sun and no signs of the storm we had passed through but a few hours before. On, on we fly into Texas with the thermometer going higher the farther we proceed. At Austin it was 70°, and our heavy underclothing felt a little uncomfortable. At Laredo we came to the border of the United States and Mexico, with a feeling that at last we were in Mexico.

From Laredo on the Rio Grande to the city of Monterey it is a distance of 170 miles. After a run of a few hours we stopped in a little town—Salinas—we found ourselves here confronting a civilization entirely different from that which we have left; here were one story huts, thatched roof, a door, but no windows, women and children at the door, and the children half naked. No floor but that of hard dirt, no furniture but a chair and stand with a lamp; a bundle of clothes in one corner, probably used as a bed. Flowers were in bloom, a species of cactus six feet high was growing everywhere, and the Spanish bayonet, a queer shaped tree of the Yucca variety was the one prominent tree in the landscape. My Vanilla expedition has now carried me about 2,200 miles from Philadelphia

into new and strange surroundings. Let us stop for a moment in the investigation of a scene of interest.

We find here a singular and instructive commentary upon the silver question that is now agitating the country. I found that in spending money that this is one of the best countries in the world for this purpose—the more money I spent the more I had left, owing to the very low price of silver, and Mexican finances being based on silver values. The Mexican dollar (or peso) is worth 65 cents, and an American dollar is worth $1.60. When I bought $1.50 worth of goods, and gave a $5 note I received $6.25 in change, and it struck me as one of the most wonderful things in political economy that I had ever seen.

My next stop was in San Louis Potosi, 300 miles from Monterey. It has a population of 60,000. On the way you cross the Tropic of Cancer and pass from the temperate to the torrid zone. Here we come to fields and fields of the green Century plant.

I next visited Toluca, some 300 miles south of San Louis Potosi, and 45 miles north of the city of Mexico, the capital of the government, where I spent nine days.

Leaving the city of Mexico I proceeded to Pueblo, then to Jalapa, and on to Vera Cruz, taking the Ward's line of steamers up the coast to Tuxpan, where I arrived after a thirty hours' sail. Here a tug came to the mouth of the Tuxpan River and took me off, steaming up the river nine miles to the city of Tuxpan. The city has 10,000 inhabitants, and is composed principally of one story, limestone, thatched houses. After spending three or four days here getting my outfit together, consisting of four mustangs, servants, guide and interpreter, we started early on Monday morning for the Vanilla land.

Hastening on, we rode through a dense forest by a bridle path, where we had to go single file, which brought us to an Indian village on the Casonies River, after some thirty miles of hard riding besides having to ford several rivers. I would state here that the sun is intensely hot at midday, so that the most of the people retire from about 11 to 2 o'clock. We stopped about 11 o'clock, at a small village composed of bamboo and thatched houses, where we waited until four o'clock before proceeding on our journey, and arriving at Casonies in the evening at about twilight. On the Casonies River we saw hundreds of Indian canoes plying up and

down this stream with both men and women propelling them, which was a curious sight. We started early next morning for Papantla, where we arrived at about nine o'clock at night. This is some thirty-five miles further inland. It is a city of about 12,000 inhabitants, and is composed mostly of one story, limestone thatched houses. This is the metropolis of the Vanilla growing district, situated in the valley surrounded by high mountains on all sides. This is the county seat. Court was in session when we arrived there, and it was impossible to get accommodations at the one hotel or any of the boarding houses. The hotel is a one-story building, composed of three or four rooms; these were all turned into sleeping rooms at night, and everybody had to sleep together—men and women—cots were arranged side by side, until there was scarcely room to get around. As the climate here is always warm, eating is done mostly out of doors. By the courtesy extended to me through letters of introduction I had, I was taken and well cared for by Mr. Tremari, who is one of the first citizens and the largest curer and shipper of Vanillas in Papantla.

At last after countless difficulties and strange experiences I am at the goal of my journey. In the land of Vanillas, in the centre of a district from which a large portion of the world's supply of this luxury is derived, and in readiness to transform into a reality the dream of years, and from here I ask you to pause with me a moment to scan briefly the history of this strange and popular product of which little is known to the general student.

When the Spaniards discovered America the custom among the Aztecs of flavoring chocolate with Vanilla was already in vogue. The former borrowed the practice from the latter and transmitted it in turn to the other nations of Europe. A few years later this valuable product became an export article, and it is believed that the first Vanilla Bean introduced into Spain came from the state of Oaxaca. It is raised in divers parts of the continent, in the Island of Cuba and other Antilles, and in some portions of Africa and Asia as well, and as a rule wherever there is heat and moisture and shade, provided the lowest temperature in winter be not lower than 65° F.

At first that which grew wild in the woods was harvested, and the inference is clear that, in proportion to its gradual diminution and increasing consumption, it was found necessary to foster its growth and in this the state of Vera Cruz took the initiatlve, being

the first place known in which the plant is under cultivation in America. Notwithstanding numerous inquiries made by me, I have found it well-nigh impossible, even with the aid of tradition to ascertain the exact time in which the cultivation began; this alone being known, that the period is a remote one. From some of the old archives of Papantla we derive the information that in the year 1760 there were already in existence Vanilla forests under cultivation. The state of Vera Cruz has had and to-day possesses great natural advantages for the production of Vanilla. But it is cultivated only in the cantons of Misantla and Papantla. For a number of years Mexico supplied the markets of the world with this product, but of late years the island of Bourbon and Java have come in competition with European markets to a marked degree.

With this brief history of the origin and nature of Vanilla start out with me on a bright, clear morning in the month of February, with the thermometer ranging from 85° to 100°; dressed in thin linen, with a light Panama hat, and mounted upon a mustang for our first visit to the Vanilla fields, located about nine miles from Papantla. The first error that you need to correct is our northern conceptions of a field. It is not here the carefully tilled, snugly fenced, and finely cultivated tract of land that characterizes the marketable products of New Jersey or Pennsylvania, but a wild, boundless, dense and almost impenetrable forest, with undergrowth so dense and rank that our mustangs must be abandoned at a by-path, and we ourselves compelled to stoop almost to a creeping posture to penetrate it. Look at yonder tree—a Mexican cedar—20 feet in height, covered with dark green luxuriant verdure, with a small tapering trunk, a few feet in circumference, and clinging to and apparently growing out of its bark observe that strange looking, clinging vine, in circumference a little larger than an ordinary lead pencil, shooting up into the tree, covering its branches, and running from it into the adjoining trees, and often forming festoons and arbors so dense and thick as to exclude the rays of the sun at noon day. Covered with a dark green, and spear shaped leaf, and hanging pendant from its interlacing branches, green pods, from four to ten inches long, and you have a picture of a Vanilla vine as I first saw it in its native soil and in its highest state of cultivation. Tree after tree in this vast forest is covered with those luxuriant vines, peeping from which, in all the glory of tropical luxuriance, are countless

hundreds of the long, luscious, tapering Vanilla Bean; in circumference almost equal to a banana and from two to three inches longer. Some of a dark green and others of a bright yellow, and sometimes where they grow most luxuriantly resembling bunches of bananas, apparently growing upon the native trees of the forests. The remoteness from civilization, the total absence of everything indicating care or cultivation, and the strange juxtaposition of this wealth of ripened fruit to the wild and unbounded woods made the scene one of the most strange and marvellous upon which the eye ever rested. Vast areas containing hundreds of square miles of contiguous territory in this province are devoted to the growth of this plant: wherever you look and wherever you travel you are confronted with this overhanging vegetation. You behold the primeval forest utilized by the half-civilized natives as a natural garden for the growth of this delicious aromatic plant.

The cultivation of the plant consists of cutting away the forests to give it room to grow. The vines are naturally grown from cuttings, the same as grape vines, but they are also grown direct from the seeds, and in such cases the fruit is much later than when the vines are planted. The vine is very hardy in its native element, and sometimes takes root even if thrown carelessly on the ground, providing it has shade and moisture. Four or five years after the vine is planted and sometimes before that period, its base rots at some distance, and before this occurs rootlets form above that portion which is dying, have already grown and descended along the tree to get nourishment from the earth. This circumstance, added to the fact, that if a reed be severed some distance from the ground, it does not die, has given rise to two distinct theories respecting this plant, which I desire here to take the opportunity of correcting; the first theory which has the support of many reputable scientists is that the plant is Epiphyte, deriving its sustenance from the atmosphere, and being independent of the soil, and the second that it is a parasite, and derives its nourishment chiefly from the trees to which it clings. A careful examination of the plant in its natural forests and a patient study of its habits and characteristics have convinced me that both of these theories are founded in error, although, before my visit to Mexico, I confess I had been led to adopt the parasitic theory, upon information from many intelligent growers.

Mr. Fuenti told me he had made the experiment of severing the reed two or three feet from the ground, and in a few days later two or more tendrils had sprung from the lower end of the vine and gone directly to the earth, thus replacing the lost base. The reed is very juicy, and when deprived of its roots tries to replace them, complying with the laws of its own existence; but this is done at its own expense, taking nothing from the tree, which statement is proved by the fact that if it consumes too much time in its endeavor to reach the soil it withers. Should the tendrils reach the soil before the reed is entirely dried up, the latter recovers later; but, if on the contrary, its strength is not sufficient to accomplish the task of reaching the earth, it gradually withers until it dies. In spite of the facility with which the reed takes root and replaces its base, some die, either because the reed was not fresh and sound or because it was damaged, or by reason of its being in localities where it received too much sun or too much shade.

I found others familiar with the Vanilla growth contending that the plant depended for its nourishment and growth upon the sap of a particular tree—the Cojondigate, and in support of this theory I was taken to the forest and shown vines growing luxuriantly around the base of this tree, showing great fertility and productiveness, and a high state of health. But upon examination of the facts I found that this tree would grow only upon certain soil, and under certain conditions, where the soil was always moist, and the reason that the Vanilla grew so much better on this than on any other, was because the conditions that so well suited the tree were the very conditions that best suited the Vanilla Plant, and when speaking of my observations in this direction, they admitted that it might be possible, and when finding in one of the gardens of Papantla, a vine growing upon a dead tree, they could not but confess, that it was perhaps not a parasite. These good people had proven to me, or assured me, in their correspondence that the plant was a parasite, and it gives me pleasure to correct the error I was then laboring under. After making diligent inquiry about the plant I had the pleasure of meeting Agopito Fontecilla, who I soon learned was an intelligent man, and who had made a scientific study of the plant, and to whom I am indebted for the greater part of my knowledge of the plant.

Taking the average of the last ten years, the number of Beans

that has been gathered each crop has been above 15,000,000 with the exception of a small quantity gathered on the southern coast of Vera Cruz, some 100,000. The remainder comes from the cantons of Papantla and Misantla, mostly from Papantla. The prices which it has attained during that time have varied much, ranging from $22 to $125 a thousand. According to the data in my possession it averages $60 to $70, and produces over $1,000,000. The smallest unripe Vanilla weighs 20 pounds to the thousand, and the largest 65 pounds to the thousand, and the average about 45 to 40 pounds. The average loss of weight in curing is about 9 pounds to the thousand. The length of the Bean varies as much as its weight, measuring from 4½ to 10 inches; the greater part ranging from 7 to 8½ inches. The plant (Vanilla Planifolia) grows a few yards in length each year, some portions of it clinging to the tree which supports it, and some remaining loose and hanging wave-like. Its thickness is about ⅜ to ½ inch. It is very juicy, round, and of a green color, knotty at intervals, leaves alternate shaped like spear and plump. The flower is yellow, and has a sweet, agreeable smell. The plant grows in length only. It does not grow anything like a grape vine, it only bears fruit upon the new portion that grows each year. The thickness of the Vanilla Bean decreases gradually from two-thirds of the lower portion to the tip. Its shape is almost round, somewhat flattened on one side, curving up to the neck which generally terminates in an arc. Its circumference varies, measuring when green from two to three inches, although the greater part measures three-fourths inches in diameter. It has a thin, smooth cuticle, with two superficial lines on either side. When thoroughly ripe its color varies from dark green to light yellow. Its lower portion is filled with small seeds, and after being treated its thickness is reduced to one-fourth of its original size. It remains black, oily, and has an agreeable perfume.

Around Misantla there are often several varieties, these are known as Misantla Bean, having thick skins. They are not packed as well, and are not considered as valuable as the Papantla curing. These varieties are designated by the natives as Cimarrona, Mestiza, Manza. When cured only an expert can tell the different goods. The wild or Pompoma Bean, Segne Xante, or sometimes called banana vanilla by the Totonaca Indians who eat them, is to be found here. This plant differs from that of the Vanilla Planifolia, in that it is much

smaller with larger leaves and less pointed. The Bean is about twice as thick and of a triangular shape somewhat resembling the ordinary banana when insufficiently nourished. It has an agreeable fragrance, resembling that of the Anise plant. It is commonly and naturally supposed that the Beans grow and thicken until approaching ripeness. It is not so, for after it is two months and a half old it ceases to increase in size. Mr. Tremari said he had made several observations during the past two years, measuring Vanilla from different vines, and has found that some after the middle and some after the last half of June have neither grown nor thickened in the least.

The vine puts forth many blossoms, but the greater part do not bear, and those attaining full growth fall, or turn yellow and crack prematurely, owing to some disease in the reed, the bean, however, clings to it. This serves as a pretext for some persons to say that in October and November the Vanilla Bean is ripe and should be cut, not bearing in mind that its apparent ripeness arrives from sickness in the plant, as shown by its defective nutrition, being soft to the touch and lacking the solidity of the ripe bean.

I found that the plants grew best in virgin soil where streams and brooks abound, and where the earth is a little sandy, and the dampness is retained longer than in any other soil; in these places the vines grow luxuriantly and vigorously, and yield large fruit, a most important factor, when one considers how scarce rain is in this section between February and July. Marshy ground is likewise undesirable, as an excess of moisture rots the vine. It is found that plants do best where a little sunlight can reach them, and the largest growers have trimmed out the heavy foliage that covers many plants. Yet vines exposed too much to the sun yield little vanilla, and what they do yield is small; the plants soon get yellow and die in a few years. On the other hand, those with heavy foliage never thicken. Their color remains a rich green, and finally sickens. The bean they yield is likewise small, badly nourished, and ripeness is retarded. After setting out the vines, if they do well, they will commence to bear fruit in about three or four years; its yield increases for four or five years, when it begins to decrease. It bears little vanilla after the tenth year. These vines yield when fully developed 85 and some as high as 200, although these are very rare. Some vines have branches that bear as much as 12 to 15 bean.

The proper time for the Mexican Vanilla Bean to ripen is in January or February, but such a demand is made for the Bean that for several years the growers begin to gather the crop in October and November, so that the harvest is over before the time it should have commenced, and this Vanilla weighs one pound less to the thousand, and remains red and subject to changes. Vanilla, if allowed to ripen naturally, remains black, juicy, and of a silvery hue shortly after its curing, and for many years it can be preserved unchanged, but if cut prematurely it is affected much, as any other fruit naturally is when picked two or three months before the time, and it never looks as it should when this is done. In order to impart to the bean all the good properties of which it is susceptible it should be cut as it becomes yellow, for, if it be cut all at once, even though it be in the month of January (as was the practice some years ago) the result will be that a great portion of it will remain unripe, because as it blooms in March, April or May, this same gradual change continues, everything being equal, until it ripens. There is, besides, another cause which brings about the same difference even in the case where they blossom together, and that is the greater or less shade afforded by the trees on which the vines grow. In former times, in compliance with an order from the government, the subdelegates, and after them the civil authorities were instructed to see that the unripe fruit should not be cut. When this duty fell to the lot of conscientious and active persons abuses were in a great measure avoided, but complete satisfactory results were far from being attained on account of the scarcity of the necessary means to watch and pursue smugglers. At other times the office was applied for by indolent persons, who regarded the orders of the government with indifference, and thus the law soon fell into disrepute, and was finally abolished by the government. The difference between the price of the Vanilla picked during October and November, and that picked after January is in the proportion of three to nine. Those acquainted with this fact seeing those Beans sell for the third what they know by their yearly experience could be sold for nine because they do not want to wait two or three additional months might think them foolish, or would imagine that poverty compelled them to suffer this loss; but it is neither the one thing nor the other, because these people are clear headed and their prosperity so general that it may be said there are no people in the world who

live in greater ease than do these people of Papantla, and this is not alone due to the fertility of the soil and the good quality of the products which are obtained by cultivation, but also because in their forests important products grow wild which are the property of any one willing to gather them. The motives actuating these people in selling the Vanilla before it is ripe, are caused by avarice on the one hand and rascality on the other. The first Vanilla sold has, as a rule, been stolen, and as it is cheap, though of poor quality, it is always a bargain for the buyer. The planters who have Vanilla Beans somewhat distant from their homes as soon as they know of any purchase or sale, cut their own Beans, fearful lest the same be stolen, as they know by experience that, immediately upon the start of such traffic, complaints are heard from the unfortunates, who in a short time are deprived of the results of hard labor and care. This abnormal condition of affairs goes on, and thefts repeatedly occur even in the best guarded Vanilla forests, whose owners cannot constantly oversee by day and by night, as other duties require their attention. For this reason they decide to cut and sell the Vanilla Bean at very low figures, rather than to suffer total loss. For no other reason is the fruit gathered and sold before it is thoroughly ripe. This unseasonable traffic, both immoral and highly prejudicial to the property interests of these cantons, should be checked by proper legislation; in this way the crop and the quality of the goods would be much greater, and its superior and delicate flavor that justly belongs to the best Mexican Vanilla Bean would make it esteemed above any other aroma in the world.

In curing Vánilla it is an easy matter to impair it either by an excess or lack of dryness, perfect curing is only attained when the Bean is left in such a condition that it remains juicy and retains its greatest possible weight, a consummation which the expert should constantly aim at. If the Vanilla is cut when ripe success will be easy, but when cut prematurely as has been the case during many years, art has to replace nature as far as possible, which can be done only through labor and substantial knowledge of the subject, so that some idea may be formed of the delicate care needed for this operation. Suffice it to say that even the best known experts sometimes permit the Vanilla to dry too much, or else, the greater part of it, not to say all, becomes filled with insects, either before or after the process of curing. It

is only necessary to allow it to remain in the sun three or four minutes more or less than is required to bring about one or the other of these results. Great care and fine eyesight are required in the separation of the diseased from the sound, because, if only one remains undetected it will mould and endanger other bundles in a short time. The curers in Papantla excel in curing and bunching the bundles, and in the regularity and evenness with which they classify the size and quality. As a rule planters do not know how to prepare the Bean, so they sell them in an unripe state to curers who yearly employ experts for that purpose. The Beans are brought in by the natives in large and small lots very similar to the way in which our country people bring in rags, butter and eggs to the town storekeeper. The Bean are first put in a sweat box, where they are sweated about 36 hours. They are then placed on mats in the sun if the day is bright and clear, if not they are placed in a large oven to dry. This requires the utmost care and attention, else the Beans are easily spoiled. After the excess of moisture is dried out, they are again sweated. This operation is repeated until they are black. They are then placed in the sun in the middle of the day only from eleven to one; they are then put in racks in Vanilla rooms, one above the other. While the curing is going on it is necessary to separate them with the utmost care; the discolored from the black bundles, the very small, the impoverished, those with skin woody at intervals, the ones with a tough, thick and smooth skin, and also the spotted, cracked or split Bean, assorting them in their respective classes. The great care to be exercised in curing Vanilla can be appreciated by what I have said before; but it is not amiss to observe that however little it is over dried it is sufficient to reduce the weight almost one pound to the thousand, which would be a great loss, besides the Bean that is over dried loses some of its color, and depreciates its value one or two dollars a pound, which amounts to as much as the loss in weight. When the Vanilla is thoroughly ripe it is easier to ascertain the required point of curing, and besides gives less trouble and is not so exposed to changes. It gets silvery white being cured, and in a few months it is crystallized, and will be preserved in this way for a number of years. If cut when unripe just the opposite happens, for not only are few crystallized but their keeping quality is poor. After the Beans are thoroughly cured, which takes from three to four months, they are assorted in different sizes

and bundled in bundles containing from 50 to 75 Beans each. The different curers having different amounts for their packing. Some 50, some 60, others 70 and some 75 to their bundles. These bundles are all uniform in size according to length, and are placed in cans of 40 bundles each; then four or five of these cans of different sizes are packed in a case made of Mexican red cedar, which is the most plentiful wood grown here. A curer stated to me that the making of these cases was the most expensive part in putting the Bean up, as they have no machinery such as saw mills and planing mills, everything must be done by hand, which necessarily takes some time to make one of these cases, as the corners of each are grooved and dovetailed together, making the case cost, when completed, from $2 to $3.

After the Beans are cased the cases are then covered with a fibre matting made here by the Mexicans and the Beans are ready for shipment. Mules or burros, in some cases mustangs, are drawn up in line and two cases are strapped on the back of each animal, and, started for the sea-coast in caravans of perhaps eight or ten animals with two or three attendants; then shipped on steamers for Europe and the United States.

In going from the interior of Mexico you will meet caravans of these beasts of burden laden with all kinds of merchandise, this being the only way of tarnsportation. The authorities for some time have been endeavoring to get a railroad to Papantla, but as yet have been unsuccessful. The Aztecs or native Indians do not want to have any improvements. Several attempts have been made to survey a road, and just before reaching there I was advised of a civil engineer who had been sent to survey a route and who was next day, after his arrival, found hanging to one of the trees outside of the town. The natives do not want anything different from what they have been used too, and will sacrifice their lives in defence of what they consider their rights.

I returned to America with a conviction that notwithstanding our national character of penetrating to the utmost corners of the earth, that as a people we know little or nothing of Mexico, a great, broad, rich, fertile tract of land, magnificently endowed by nature and so favorably located, as respects soil, climate and physical conditions, that in my judgment it is ere long to become the most prolific source of supplies for many of the essential and valuable products

needed by the world, and of her varied and valuable industries, none are more promising and give indications of more important growth than does the Vanilla Bean. The infusion of greater intelligence in the minds of the natives engaged in its development, the employment of better means for its preservation and cultivation, the opening of newer and larger districts for its supply and a more intimate and scientific knowledge of its natural requisites, would in a few years multiply manifold the volume of this commerce, and would permit it to be placed upon our markets and markets of the world in a far better condition, as respects quality, and at a price that would largely stimulate its use.

I returned to Philadelphia satisfied that my expedition had been of great practical value to me, and that if more merchants and business men, deeply interested in handling and marketing Vanillas could be induced to turn their interest and attention to the conditions and restrictions that surround the production, many of the difficulties and hazards that retard its cultivation, that make its production so precarious, and mar its perfections, and so materially increase the cost of transportation, would in a few years be materially overcome.

I look at the Vanilla Bean with a new interest. I see in it something of the history of a peculiar people. Its delicate aroma is to me suggestive of the bright blue sky, the blazing sun, the tropical luxury, and the rich atmosphere of the country where it grows, almost the spontaneous child of nature, yet so potential and useful in the varied needs of our complicated life of to-day.

I trust that the brief and hurried view of its habits and peculiarities that I have been able to give you in this brief talk have been of some interest and value from a scientific standpoint and may have tended to render more accurate and definite your botanic knowledge of the Vanilla Plant, and may have cleared away some of the superstitions and uncertainties that have in the past clouded its history. If so, the object of my talk will have been fully accomplished, and I will have been fully repaid for the little time I have spent in throwing together the somewhat desultory remarks.

NOTES ON THE EXAMINATION OF BEESWAX.

By Lyman F. Kebler, Ph.C., B.S.

Read before the Philadelphia College of Pharmacy, November 21, 1893.

When the contribution[1] on "An Examination of Beeswax," by E. G. Parry and P. A. Estcourt appeared as representing the sophistication of this article in the English market, the writer had nearly completed a communication on the same subject in the United States.

The waxes examined, and the results submitted below, were samples sent to this laboratory during the past year and fairly represented the commercial article.

Beeswax is a mixture of *myricin*, *cerin* and *cerolein*. Myricin ($C_{46}H_{92}O_2$) forms the chief constituent of wax, is insoluble in alcohol and fuses at 64° C.

Cerolein constitutes only from 4–5 per cent. of the wax, has an acid reaction and is the constituent to which wax owes its tenacity, odor and color.

Cerotic acid or cerin ($C_{27}H_{54}O_2$) is not a constant in beeswax.

B. C. Brodie,[2] in his classic work, "Untersuchung über die chemische Natur des Wachses," has shown that cerin consists essentially of a high fatty acid, *i. e.*, cerotic acid while myricin is the palmitic ether of melissic alcohol. F. Schwalb[3] and F. Nafzger[4] have proven wax to contain small quantities of acids related to cerotic acid as melissic acid, also some non-saturated acids of the oleic acid series and some alcohols related to cerylic alcohol as melissic alcohol. They have also proven it to contain saturated hydrocarbons, such as hentriacontane ($C_{31}H_{64}$) and heptacosane ($C_{27}H_{50}$).

It was thirty-four years after the composition of beeswax was made known or the way paved for the introduction of a method before a method was proposed for the examination of this article based on the determination of the free and combined acids, respectively.

The Acid and the Ether Numbers —These were determined by the

[1] 1893, read before the Brit. Pharm. Conference; Nottingham, through the Am. Drug. and Pharm. Record, **23**, 158.

[2] 1848, Ann. Chem. (Liebig), **67**, 180; Phil. Trans., London, **136**, 147. 1849, Ann. Chem. (Liebig), **71**, 144.

[3] 1884, Ann. Chem. (Liebig), **224**, 225.

[4] 1886, Ibid., **235**, 106.

well-known method of Hübl[1] (not the iodine number) who was the first to apply the method in a practical way. The method is sometimes awarded to Hehner, who translated his results into cerotic acid and palmate of myricle. Hehner[2] applied the method about half a year before Hübl, but Becker[3] was the first to apply the principle of Köttstorfer[4] to the analysis of beewax. Hübl's method is now recognized as the most elegant, most convenient as well as the best method for establishing the purity of this article. The method[5] in detail is: heat 3 or 4 gms. of the wax with 20 cc. of neutral, 95 per cent. alcohol, titrate while hot with a seminormal alcoholic solution of potassium hydroxid and phenolphthalein, to estimate the acid number, now add 20 cc. more of the alkaline solution and saponify by boiling the solution briskly with a reflux condenser for one hour to insure complete saponification. The excess of alkali, is then titrated back with seminormal hydrochloric acid. The number of mgs. of potassium hydroxid required to saturate the free acids of *one gram* of wax is called the "acid number," that required to decompose the wax ethers the "Ether Number."

The acid number varies from 19–21 mgs., the ether number from 73–76 while their ratio is from 1 : 3·5 to 1 : 3·8. For complete saponification from 92–97 mgs. of potassium hydroxid are required. After having secured the acid and the ether numbers the quantity of cerotic acid or its equivalent and myricin are easily calculated. Extreme care must be taken in the titrations on account of the extraordinarily high molecular weights of both cerotic acid (410) and myricin (676). 1 cc. of normal alkali represents 410 mgs. of cerotic acid and 676 mgs. of myricin, respectively.

Determination of the Alcohols.—Unquestionably the alcohols of beeswax belong to the same series, consequently they possess the same chemical properties. Dumas and Stas described an important reaction of the fatty alcohols, viz: the reaction which they give when heated to a moderate temperature with potassium hydroxid. These alcohols when so treated are converted into the correspond-

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[1] 1883, Dingl. poly. J., **249,** 338.

[2] 1883, Analyst, **8,** 16.

[3] 1880, Corr. Bl. Ver. anal. Chem., **2,** 57; Abst. Zeit. anal. Chem., **19,** 241.

[4] 1879, Zeit. anal. Chem., **18,** 199 and 431; Analyst, **4,** 106.

[5] 1892, H. Röttger, Chem. Ztg., **16,** 1837; J. Chem. Soc., **64,** 351. G. Buchner, Ibid., **16,** 1922; Ibid., **64,** 351.

ing acid or alkaline salt and hydrogen is simultaneously disengaged. For example, when melissylic alcohol is distilled with potassium hydroxid the alcohol is decomposed, hydrogen being evolved on the one hand and potassium melissate formed on the other, or recalling a more familiar example where potassium acetate is formed by treating ordinary alcohol in a similar manner. The constituents of wax, not alcohols, are not affected by this treatment, consequently by measuring the volume of hydrogen evolved, from a given weight, the proportion of alcohols can be approximately estimated. C. Hell,[1] H. Strürcke[2] and F. Schwalb[3] applied the above reaction to beeswax long before MM. A. and P. Busine[4] did, but it was these last two investigators who simplified the apparatus and studied the conditions of success. They proceed as follows: melt 2–10 gms. of the wax in a porcelain dish, mix with an equal weight of pulverized caustic potash, mix the mass again with three or four times its weight of pulverized caustic potash, then introduce the mixture into a flask and heat on a mercury bath to 250° C. for two hours. The reaction begins at 180° C. The volume of hydrogen evolved by one gram of the wax varies from 53·5–57·5 cc., at 0° C. and 760 mm. pressure, corresponding to a percentage of melissic alcohol varying from 52·5–56·5.

Determination of Hydrocarbons.—The hydrocarbons are determined very readily by treating the residuum of the preceding determination with an appropriate solvent, such as ether. In the above residue all the acids of the wax and the alcohols have been transformed into a state of alkaline salts, while the hydrocarbons alone remain intact. Hydrocarbons are found in wax in almost constant quantity, varying from 12·72–13·78 per cent.

The writer did not execute the last two operations because the apparatus of M. Dupre was not available.

The Iodine Number.—By treating wax with iodine a new number is obtained which is of considerable value for analytical purposes. This number was determined by the conventional method, Hübl.[5] The

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[1] 1884, Ann. Chem. (Liebig), **223,** 269; Chem. Ztg., **8,** 859.

[2] 1884, Ibid, **223,** 295; Chem. Ztg., **8,** 860.

[3] 1886, Ibid, **235,** 106.

[4] 1890, Bull. Soc. Chim. (3), **3,** 567; Chem. Ztg. Reper., **14,** 225.

[5] 1884, Dingl. poly. J., **253,** 281; J. Chem. Soc., **46,** 1435; Am. Chem. J., **6,** 285; J. Soc. Chem. Ind., **3,** 641.

amount of iodine absorbed by the wax being small it was necessary to use a larger quantity of the substance than ordinarily, consequently more chloroform was needed. The method[1] in detail is: dissolve two grams of the wax in 40 cc. of chloroform in a glass stoppered flask. Add 25 cc. of an iodine solution, containing 25 gms. of iodine and 30 gms. of mercuric chloride dissolved in 95 per cent. alcohol and made up to one liter, and shake. Place the flask into a dark closet for three hours, then add 15 cc. of a 10 per cent. solution of potassium iodide and 100 cc. of water, finally titrate the free iodine with a standardized solution of sodium thiosulphate. The "Iodine Number" expresses the per cent. of iodine absorbed by the wax. It is quite essential to carry blank experiments in order to secure reliable results.

The Melting Point.—This is determined as follows: dip the bulb of the thermometer into the sample of melted wax, for an instant, on cooling, the bulb is covered with a film of the wax, introduce the thermometer into a wide-mouthed bottle through its perforated cork. The bottle is now hung into a beaker containing water at about 65° C.; carefully noting the temperature at the instant a hanging drop is formed, this is taken as the melting point. Other[2] methods were used but the above method gave concordant results without consuming too much time.

Specific Gravity.[3]—This was obtained by diluting alcohol so that the wax, previously melted and cooled normally would float indifferently in it. The specific gravity of the alcohol being identical with that of the floating wax it is necessary only to secure the specific gravity of the liquid with a picnometer or a specific gravity spindle and we have the specific gravity of the wax. The most trustworthy methods employed for securing the specific gravity of fats, waxes, etc, are given in the *U. S. Bull., No.* **13,** 40–43.

Stearin, Stearic Acid, etc.—Any foreign acid can easily be detected

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[1] U. S. Bull., No. **13,** 818.

[2] 1883, Guichard, Proc. Royal Soc. Ed., **106,** 432, 532; Zeit. anal. Chem., **22,** 70.
1884, H. Krüss, Zeit. f. Instrumentenkunde, **4,** 32.
1886, C. Reinhardt, Zeit. anal. Chem., **25,** 11.
1887, H. W. Wiley, J. Anal. Chem., **1,** 39.

[3] 1879, Hager, Analyst, **4,** 206.

by Hübl's method. Fehling's method[1] gives an unmistakable turbidity with *one per cent.* of stearic acid and is executed thus: boil one gram of the wax in a test tube with 10 cc. of 80 per cent. alcohol for a few minutes, allow to cool to 18° or 20° C., filter, to the filtrate add water and shake. If stearic acid is present it separates in flocks on the surface, leaving the underlying fluid nearly clear.

A. H Allen[2] gives a method depending on the insolubility of lead stearate in alcohol. Proceed thus: boil the wax for 40 minutes with 20 parts of alcohol, cool, the cerolein and some of the stearic acid remain in solution. Filter and treat the filtrate with an alcoholic solution of lead acetate, if a flocculent precipitate of lead stearate is formed, stearic acid is contained in the wax.

F. Jean's method[3] was also tried but proved unreliable, at all events waxes proven to be free from stearic acid by Hübl's and Fehling's methods gave unmistakable evidence of stearic acid.

7·8 cc. of seminormal alkali equals one gram of commercial stearic acid.

Stearin may be detected by the methods employed for stearic acid.

Rosin.—E. Donath's method[4] modified by E. Schmidt[5] was applied in each case and is executed thus: place 5 grams of the wax into a flask, add 20 cc. of crude nitric acid (sp. gr. 1·32) heat the mixture to boiling and keep at this temperature for one minute. Add an equal bulk of cold water, then an excess of ammonia water. With pure wax the alkaline fluid is colored yellow only, but in presence of rosin a deep brown.

Paraffin.—Paraffin is a common adulterant of beeswax, in fact, some samples of wax might more appropriately be reported adulterated paraffin for as high as 80 per cent. of this substance has been found mixed with wax in our markets.

There are many methods[6] for detecting paraffin and its allies but the process of the U. S. Pharmacopœia has given the writer results as reliable as any and is outlined thus: "If 5 Gm. of Yellow Wax be

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[1] 1858, Dingl. poly. J., **147,** 222; see also Chem. Ztg., 1890, **14,** 606.

[2] Commercial Organic Analysis, **2,** 213.

[3] 1891, Bull. Soc. Chim. (3), **5,** 3.

[4] 1873, Ding. poly. J., **205,** 131; Abst. Zeit. anal. Chem., **12,** 325.

[5] 1877, Ber., **10,** 837; Zeit. anal. Chem., **17,** 509.

[6] See References, U. S. Bull., No. **13,** 828, and Chem. Ztg., 1890, **14,** 607.

heated in a flask, for fifteen minutes with 25 cc. of sulphuric acid, to 160° C., and the mixture diluted with water, no wax-like body should separate." Care, however, must be exercised in applying the test as has been shown by C. C. Sherrard[1] and C. M. Morse.[2]

The paraffin is estimated by decomposing a weighed portion of the wax with concentrated boiling sulphuric acid, the charred mass cooled, washed with water, dried and extracted with a Soxhlet's apparatus by means of ether. The paraffin hydrocarbons are thus obtained in a fairly pure state.

Japan Wax.—E. Buri[3] regards this wax as a mixture of glycerides and not as a dipalmatin. There are a number of methods claimed by their various authors to be efficient in detecting this adulterant in beeswax, but none has proven itself very effective in the writer's hands. The borax[4] and sodium carbonate[5] methods only deserve mention. Experience has shown that it would be better to abandon the borax method also or at least be *extremely cautious* in judging from its results, for the separation into layers takes place easier on paper than in the test tube.

Donath's[5] general reaction for rosin, tallow, stearic acid and vegetable wax gives a valuable indication but is not specific enough. He directs to boil 1 or 2 grams of the wax with 6 or 8 cc. of a concentrated solution (1–6) of sodium carbonate for one minute; if an emulsion ensues which is persistent after the liquid has cooled, the wax contains one of the above adulterants.

Soap.—This adulterant can easily be detected by boiling a small piece of the wax a few minutes with water, cooling, filtering and treating the filtrate with hydrochloric acid. A precipitate indicates the presence of a soap.

Mineral matters.—Such substances as *kaolin, gypsum, heavy spar, yellow ochre*, etc., are said to be frequently used as adulterants for beeswax, but examinations of late show that the days of such gross sophistication is nearly past. Adulteration of recent days has in many cases assumed the position of a science.

Starches.—The various starches can easily be detected with the

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[1] 1892, Proc. Am. Pharm Assoc., **40**, 252.
[2] 1888, Thesis, College of Pharm., Mass.
[3] 1879, Arch. d. Pharm. (3), **14**, 403.
[4] Hager, 1862, Pharm. Centrhalle, **3**, 207; 1880, Dingl. poly. J., **238**, 356.
[5] Donath, 1872, Dingl. poly. J., **205**, 131; Allen's Com. Org. Anal., **2**, 212.

aid of a microscope or by boiling a small piece of the beeswax with a little water, cooling, filtering and to the filtrate adding a few drops of a test solution of iodine. A blue coloration indicates a starch.

Serial Number.	Melting Point.	Specific Gravity at 15° C.	Acid Number.	Ether Number.	Total.	Ratio.	Cerotic Acid.	Myricin.	Total.	Ratio.	Iodine Number.	Adulterants.	Description.
1	64·41	·9600	20·30	74·20	94·50	3·650	14·86	89·57	104·43	6·028	8·35		Pure Yellow Wax.
2	62·81	·9608	20·40	70·00	90·40	3·418	21·52	84·50	106·02	3·92	9·31	—	" "
3	63·20	·9602	18·20	65·80	84·00	3·614	13·32	89·57	102·89	7·731	8·50	Stearic Acid.	" "
4	63·80	·9624	20·10	77·00	97·30	3·788	14·86	92·95	107·81	6·547	8·71	—	" "
5	54·42	·9120	14·70	45·59	60·29	3·101	10·76	45·63	56·39	4·240	5·63	Paraffin.	" "
6	63·81	·9641	19·60	75·60	95·20	3·857	14·35	91·26	105·61	6·352	7·26	—	Pure Bleached Wax.
7	63·43	·9630	20·10	74·20	94·30	3·681	14·85	89·57	104·42	6·028	6·80	—	" "
8	64·44	·9710	20·30	77·00	97·30	3·788	14·86	92·95	107·81	6·193	6·30	—	" "
9	62·23	·9650	19·60	65·80	85·40	3·357	13·35	76·93	90·28	5·755	9·80	—	" "
10	60·00	·9420	26·20	59·50	85·70	2·260	18·45	71·82	90·27	3·892	11·10	Paraffin, Stearic Acid.	Pure Unbleached Wax.
11	63·00	·9620	18·04	74·49	92·53	4·132	13·16	89·95	103·11	6·821	8·70	—	" "
12	63·10	·9581	29·40	71·40	100·80	2·430	21·52	86·19	108·71	4·00	9·66	Stearic Acid.	" "
13	59·00	·9431	17·50	71·35	88·85	4·010	12·81	87·03	99·84	6·89	7·00	Paraffin.	" "
14	64·41	·9581	17·50	67·20	84·70	3·842	12·81	81·12	93·93	6·254	13·10	Paraffin, Rosin.	Manufacturing Wax.
15	62·45	·9501	18·91	71·51	90·42	3·776	12·83	86·33	100·16	6·232	9·11	Paraffin.	Pure Unbleached Wax.
16	63·70	·9520	20·30	74·20	94·50	3·655	14·86	89·57	104·43	6·027	7·42	—	" "
17	62·81	·9690	21·70	81·90	103·61	3·772	15·89	98·86	114·75	6·221	4·31	Probably Japan Wax.	Pure Bleached Wax.

Above is given a table embodying the results of the analysis of *sixteen* samples of the wax as received, of these *eight* were pure and *eight* adulterated.

Wax number one is placed at the head as a standard because it is of known purity and is not to be included in the sixteen samples.

Neither number *three* nor number *nine* contained any detectable adulterant yet the ether number is low. Several trials were made, in both cases, to obtain a higher ether number but without success.

Each sample was boiled for *two hours* so that saponification ought to have been complete, yet the difficulty might lie here, for R. Benedikt and K. Mangold say[1] that this method is attended with the disadvantage of saponifying some kinds of wax with difficulty. These investigators base their results on what they call "aufgeschlossenes Wachs."

In view of the facts that some wax saponifies with difficulty, that no adulterant was found and the remaining data were approximately normal, these waxes claim a position among the unadulterated.

Samples number *two* and *twelve* contain stearic acid or an equivalent, yet the specific gravity and the melting point conform in each case as nearly to those of pure wax as could be required. How the manufacturer succeeded in doing this is a question for us to solve.

Heintz[2] has shown that by mixing stearic and palmitic acids in different proportions a melting point varying from 69·2° C. to 55·1° C. can be secured. Was it a mixture of this kind? The writer was unable to determine.

The use of stearic acid, as an adulterant for beeswax, must be of comparatively recent date for Hassal, in his admirable work, who generally enumerates every conceivable adulterant, does not allude to it, and Allen, in his Commercial Organic Analysis, **2**, 213, says it is "Less frequently employed than some of the other adulterants."

The results above show, and other recent investigations corroborate it, that stearic acid is employed almost as extensively as any other adulterant for this purpose.

Rosin was found only in the sample designated "Manufacturing Wax."

Indications point to the presence of Japan wax in number seventeen, but nothing definite can be ascertained, owing to the present inefficient methods at our disposal.

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[1] 1891, Chem. Ztg., **15**, 474.

[2] Ann. der Physick, **92**, 588; Dragendorff's Plant Analysis, 1884, Eng. Ed., p. 15.

Below is a table embodying the properties of the various substances employed in adulterating beeswax. A few of the data are those of the writer, but the majority were secured from various sources in literature.[1]

SUBSTANCE.	Melting point.	15° C. specific gravity.	Acids soluble in water.	Acid number.	Ether number.	Total.	Iodine fixed by one gram of wax.	Volume of Hydrogen at 0° C. and 760 mm. pressure given per gm.	Hydrocarbons from one gram of wax.
Yellow beeswax, . . .	62–64	·961– ·964	0–1	19–21	73–76	91–97	8–11	53–57·5	12·5–14·5
Beeswax bleached by various agents, . . .	63–64	·960– ·973	0–2	19–23	74–84·29	93–107·7	1·08–11·36	51–57	11–14·30
Cacao butter, ...	30–33	·945– ·982	0	0–3	192–200	192–204	34	—	—
Carnauba wax, ...	83–84	·999	0	4–6	75–76	79–82	7–9	73–76	1·6
China wax, ...	53·5	·970	2	22	196	218	6·85	72·3	0
Japan wax, ...	47–54	·975	2	18–28	194–198	216–222	6–7·55	69–71	0
Mineral wax, ...	60–80	·918– ·952	0	0	0	0	0–0·6	0	100
Paraffin, ...	38–74	·913– ·914	0	0	0	0	17–31	0	100
Resin, ...	53·5	1·104–1·108	0	168	10	178	135·6	35	0
Spermaceti, ...	40–50	·945– ·96	0	0–2	136–142	136–144	—	—	—
Stearic acid, ...	53·5–69·2	·901–1·00	0	204	5	209	2–4	0	0
Suint wax, ...	62–66	—	0	95–115	4–7	102–119	13–18·5	0	14–18
Tallow, ...	42–50·5	·952– ·96	0	2·75–5	193–208	196–213	27–40	52–60	0
Vegetable wax, ...	47–55·6	·947	2	17–19	200–210	218–220	6·6–82	73–74	0

GENERAL CONCLUSIONS.

Beeswax in our markets is adulterated to the extent of 50 per cent. while in English markets it rises to 66⅔ per cent.

The melting point of beeswax varies from 62–64° C.; it is raised by adding carnauba wax, stearic acid, certain mineral waxes and paraffins. China wax, Japan wax, cacao butter, resin, tallow, spermaceti, vegetable wax, certain stearic acids and paraffins lower it, while it is apparently unaltered when adulterated with suint wax, certain mineral waxes, paraffins and stearic acids.

Beeswax varies in specific gravity from ·960–·973 and appears to be greatly influenced only by resin, carnauba wax and certain mineral waxes, which increase it, and paraffin which lowers it.

The "Acid Number" ranges from 19–21 mgs. of potash per

[1] 1882, Dieterich, Arch. der Pharm. (3), **20**, 454. 1885, O. Dammer, Illustriertes Lexicon der Verfälschungen, etc. 1891, A. and P. Busine, Bull. Soc. Chim. (3), **5**, 654. R. Benedikt, Analyse der Fette und Wachsarten, Zweite Auf., 311, *et seq.*

gram of beeswax. Stearic acid, resin, and suint wax increase while carnauba wax, mineral wax, cacao butter, paraffin and spermaceti decrease the acid number. China wax, Japan wax and vegetable wax do not vitiate the number seriously.

The "Ether Number," varying from 73–76 mgs. of potash per gram of beeswax, is unaffected by adding carnauba wax but China wax, Japan wax, cacao butter, tallow, vegetable wax, increase it. Mineral wax, paraffin, resin, stearic acid and suint wax decrease it. It must be noted that wax bleached by certain chemical agents may have an ether number as high as 84 and yet be pure.

The percentage of iodine varies from 8–11, yet wax bleached by certain agents, as chlorine, may vary far from these percentages. Paraffin, mineral wax and stearic acid lower the percentage, but cacao butter, resin, suint wax and tallow increase it. China wax, carnauba wax, Japan wax and vegetable wax pass the prescribed limits but very little.

The volume (53–57·5 cc.) of hydrogen evolved from one gram of beeswax and the percentage (12·5–14·5) of hydrocarbons evidently are the most reliable data securable. The former being vitiated by all adulterants except tallow and the latter by all except suint wax. —Laboratory, Smith, Kline & French Company, Philadelphia, Pa.

WEIGHTS OF THE UNITED STATES PHARMACOPŒIA, 1890.

By Allen Shryock, Ph.G.

Read at the Pharmaceutical Meeting, November 21, 1893.

A careful examination of the United States Pharmacopœia presents the following facts, which may be of interest to friends of the Decimal System.

The greater proportion of quantities indicated by weight, come under the head of 1000, 100 and 10 Gramme weights.

The following table will show about the number of times that each particular weight is directed throughout the Pharmacopœia:

	Times.
1,000 gramme weight,	167
100 " "	110
10 " "	49
200 " "	38
50 " "	34
20 " "	33

	Times.
4 gramme weight,	24
500 " "	19
6 " "	18
40 and 150 gramme weights, each,	17
1 " 30 " " "	16
5, 15 and 80 gramme weights, each,	15
60 gramme weight,	14
2 " "	13
90 " "	12
12 and 800 gramme weights, each,	10
65 " 700 " " "	9
25, 120, 300 and 400 gramme weights, each,	8
3, 8, 70 " 85 " " "	7
13 and 180 gramme weights, each,	6
35, 140, 350 and 850 gramme weights, each,	5
7, 45 and 750 gramme weights each,	4
9, 18, 34, 38, 55 and 650 gramme weights, each,	3

33 56 75 93 95 98
125 160 170 250 330
600 720 760 944 gramme weights, each twice.

The following weights are directed but once:

16	17	19	27	29	31	46	47
57	63	67	71	77	78	83	94
110	130	175					
219	220	230	236	240	260	280	
310	319	320	340	370	375	410	490
520	550	555	580	640	670	675	680
770	825	840	870	900	920	925	950
1050	3200		6000				

Decimal quantities, each once, as follows:

·06 — ·16 — ·2 — ·50 — ·5 — 1·2 — 2·5 — 6·5 grammes.

We find that in making up all the preparations given in the U. S. P., of 1890 (where weight is indicated), that about 122 different quantities are directed, while the number of times that these quantities are expressed in Gramme Weights, including duplicates, are about 906.

In view of the fact that the correct working of the formulæ of the U. S. P. involves 122 different weights, 906 times in all, it is of the greatest importance to the pharmacist to be able to weigh these quantities with accuracy and despatch.

In no other way can this be done, but by the *direct* use of the *metric weights.*

The conversion of these weights into their relative *exact* equivalents is an utter impossibility—and though the error may be of no practical importance, it is certainly no true representation of the terms employed.

If we wish to weigh 1,000 Grammes let us use a Thousand Gramme Weight—and not 32 Troy Ounces and 72·4 Grains.

If the Decimal System is our *theory*, let the Decimal System be our Practice also.

The total weights added together of all the quantities indicated in the U. S. P. amounts to about 277,700 Kl. Gr., and the total resulting error collectively by the substitution of Ounces and Grains in the place of Kl. Grms. amounts to over 12,000 Grains, or about one-twenty-fifth of a Grain to the Kil. Gr.

Another curious fact brought out in connection with the substitution of Troy Ounces and Grns. for Kil. Grms. Allowing one minute for consulting the table for converting each of the 906 Weights mentioned into Troy Weight, we are wasting over fifteen hours' time beside risking chances of error.

In view of these facts why not adopt the System bodily which our faithful and honored committee have given us after so much labor?

THE UNITED STATES PHARMACOPŒIA OF 1890.

By George M. Beringer, A.M., Ph.G.

[*Continued from p. 528.*]

On page 167, we are told that syrupus sarsaparilla compositus is made from the compound fluid extract of sarsaparilla. It is the fluid extract of sarsaparilla that is directed in the formula for syrup and not the compound fluid extract.

The formula and process for the manufacture of Ferric Chloride should be omitted. It is now supplied in a pure condition, and at such price by manufacturers that the pharmacist will not attempt its preparation.

As the *soluble* Citrate of Iron and Quinine has been introduced, in which the percentage of Iron and Quinine is practically the same as in the Iron and Quinine Citrate, the latter might now be omitted.

In the preparation of Saccharated Ferrous Iodide, one per cent. of reduced iron is added to preserve the ferrous iodide from change to ferric salt. The term "soluble" has been attached to the official

title for Ferric Phosphate and Ferric Pyrophosphate, and serves well to indicate that these are not the pure chemical salts that the names previously adopted seemed to indicate.

Granulated Ferrous Sulphate is no longer directed to be granulated by the addition of alcohol to the concentrated aqueous solution. Alcohol is only directed to be used to wash the product granulated by constant stirring while the saturated solution is cooling.

Ferric Valerianate is admitted to be of varying composition, and the chemical formula is omitted.

Glycerites of Carbolic Acid and of TannicAcid are two old friends of 1870, restored to their rightful position. In the latter, the directions should require that the tannic acid and glycerin be rubbed in a mortar to a smooth mixture, and then transferred to a capsule and heated on a water-bath until dissolved.

In Glycerite of Starch 10 per cent. of water is introduced in place of that amount of glycerin. Glycerite of boroglycerin and Glycerite of Hydrastis are two new additions. The former is a deserved recognition of a frequently used and good remedy, the latter we are doubtful about.

The official Mercurous Iodide is *yellow*, and this is indicated in the title by changing "viride" to *flavum*, and it is now directed to be made by precipitating mercurous nitrate with potassium iodide. Manufacturers have for years listed both yellow and green mercurous iodide, the color being dependent on the amount of mercury present. The Mercuric Iodide is made as heretofore from mercuric chloride and potassium iodide, but the solutions of the salts are directed to be simultaneously poured into a quantity of distilled water.

That the formula of the Pharmacopœia of 1880, for Mercury with Chalk was very unsatisfactory is admitted, and we are not sorry to see it abandoned. In the Pharmacopœia of 1890, clarified honey is used to disseminate the mercury. It is to be observed, that the formula prescribes 105 gm. of material to yield 100 gm. finished product, which would require a loss of 5 gm. (50 per cent.) of moisture by the honey.

We are somewhat surprised to find the hydrochloride of the artificial alkaloid *hydrastinine* introduced, and not the alkaloid *hydrastine* from which it is derived. While the reports of the hæmostatic value of the former are favorable, we were not aware that its use had extended beyond the experimental stage, but the latter has been

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extensively used for some years, especially as an application to mucous membranes, and the alkaloid hydrastine or its hydrochloride should have been introduced.

Hyoscine Hydrobromide and Hyoscyamine Hydrobromide are deserved admissions. Aconitine and Homatropine Hydrobromide should also have been admitted as their use would necessitate recognition.

Infusions and decoctions have both been reduced to five per cent. unless otherwise directed, and maceration in the former is directed for an half hour only. The formula for Infusion of Digitalis is changed again. In 1870, tincture of cinnamon was directed; in 1880, cinnamon and now cinnamon water. The digitalis is now rightly directed to be bruised not powdered. Maceration is only until the mixture is cold, not for two hours as heretofore.

Iodoform is official only in crystals, but it is now generally seen in powder only.

Jalap is still required to yield "not less than 12 per cent. of resin." Shortly after the revision of 1880, Dr. Squibb, Turner and Drescher, all reported examinations showing that the jalap in the market yielded less than 10 per cent. resin. While recently, some lots have appeared in the market yielding 12 per cent. that requirement would exclude most in the market. It would have been as well to have fixed the limit at not less than 10 per cent.

Lemon Peel is official for the sole purpose of using it in spirit of lemon, yet the lemon peel described under the official title of "Limonis Cortex" is not that directed in spirit of lemon. The description should be "*the outer or yellow epidermal surface grated from the ripe fruit.*"

Linimentum Calcis is again *linseed oil* and lime water, old "carron oil." The substitution of cotton-seed oil in this and in Linimentum Ammoniæ by the Pharmacopœia of 1880, was an inexcusable blunder and the retention of this oil in the volatile liniment of 1890, is a persistent continuation in a palpable error which is beyond explanation. Olive oil is admittedly the best for this purpose, producing the smoothest and thickest liniment. The very consistence of the liniment produced, giving it the property of retaining the ammonia for a time, assuring the action desired and rendering it more valuable than the other oils which saponify less perfectly with ammonia. It is amusing to note the substitutes that have been proposed

rancid cotton-seed oil, paraffin oil, lard oil, linseed oil and the new Pharmacopœia proposes cotton-seed oil with the addition of some alcohol. The change to cotton-seed oil has been excused by the statement that pure olive oil was not obtainable. This argument, if valid, would require the substitution of cotton-seed oil soap for the official soap and the use of cotton-seed oil in lead plaster and other official preparations. At no time within the last 15 years has it been difficult to obtain either in Philadelphia or New York olive oil of such purity and at moderate prices yielding satisfactory pharmaceutical preparations. The formula of the Pharmacopœia of 1870 for volatile liniment has not been improved upon, and should have been reinstated in the revision of 1890.

In Soap Liniment, the soap is directed to be in fine powder; as the official soap is in lump and containing considerable water (not over 36 per cent. U. S. P.) I presume this is soap which has been dried. If so, the formula should read "Soap previously dried at a temperature not exceeding (100° C.?), and reduced to a fine powder 70 gm."

Ground Flaxseed, if pure and recently prepared, will yield 32 to 35 per cent. of fixed oil, yet the official requirements are only 25 per cent., which would admit of considerable adulteration.

In the formula now adopted for Basham's mixture, glycerin is used in place of the syrup. The iron strength still remains at 2 per cent. of tincture by volume—too weak. The original formula for this preparation contained a little over 6 per cent. by volume.

In the Solution of Magnesium Citrate, the water should be directed to be boiled and used, while hot; this renders the solution more permanent, probably by destroying fungus spores. The amount of syrup directed in this preparation, 120 cc., is entirely too much, 60 cc. would be sufficient.

In Solution of Chlorinated Soda a decided excess of sodium carbonate is directed rendering the finished product distinctly alkaline, as it should be.

In Liquor Ammonii Acetatis the second process of the previous Pharmacopœias, in which the ammonium carbonate and acetic acid were prepared in separate solutions and these mixed at the time needed, has been discarded. By many *practical pharmacists* this is deemed the better of the two processes. The term "spirit of mindererus," has become obsolete and is so inaccurate a name, according

to our present idea of a spirit, that it should be omitted as an official synonym.

Effervescent Lithium Citrate should have been directed to be granulated. Using the salt and not the lithium carbonate and citric acid, to prepare same when dissolved, tartaric acid could have been substituted for the citric acid to produce effervescence.

While native Manganese Dioxide, containing 66 per cent. of the dioxide, is pure enough for preparing chlorine water it is not sufficiently pure for internal administration. Manganese dioxide is now largely administered as an emmenagogue and alterative and a pure oxide should have been introduced for this purpose and a note of caution under the present official oxide, explaining that it was not intended for internal use.

Very little of the *natural* copaiba will yield Mass of Copaiba by the official process until a portion of the essential oil is distilled off. The addition of one per cent. sodic hydrate dissolved in a little water improves the solidification of the mass.

The introduction of Methyl Salicylate into the Pharmacopœia is unwarranted by either use or character of the product. Its principal use has been as an adulterant of the natural oil of wintergreen and a test that would readily detect its presence in this oil has been a desideratum. As a product, it is itself liable to contamination with other synthetic products from impurities present in the salicylic acid used in its manufacture, and it is, in addition, notoriously adulterated.

Its introduction into the Pharmacopœia, is accompanied with tests for the detection of some of these adulterants. The official tests for methyl benzoate would fail to detect the presence of a small amount of that product. It lays claim to no superiority and possesses no advantages over the natural oil of wintergreen. The latter is extensively used both internally and externally, and I have yet to see or hear of the physician who knowingly ordered or accepted the synthetic oil. On the other hand, the statement is made by some that the salicylic acid made from the natural oil of wintergreen has a better remedial effect than that made synthetically. The only claim that methyl salicylate appears to advance is that it is a cheap substitute. While this might appeal to the soap manufacturer it is beneath the self-respect of the honest pharmacist and the dignity of the Pharmacopœia to recognize such reason. This introduction of

synthetic oil of wintergreen becomes a dangerous precedent. If synthetic oil of wintergreen is to be officially recognized, why not introduce also the synthetic essential oils of almond and of mustard?

The theoretical necessity for a more accurate classification of the pharmacopœial preparations, alone, seems to have decided the Committee in dividing the old class of mixtures. In the past, pharmacists have felt the need of at least one class of liquid preparations, wherein might be grouped such preparations as could not be properly classed under the more rigid titles, as tinctures, syrups, liquors, etc. The title "mistura" was deemed sufficiently elastic, and it has always conveyed the idea of a heterogeneous group of remedies. This want has been universal and in the British Pharmacopœia and in other national pharmacopœias, we have similar groups under this title. Under the new classification mixtures are more nearly related to the emulsions than heretofore. It remains to be seen if the new class "Emulsa" will be more graciously received than were the abstracts of the Pharmacopœia of 1880.

Some peculiar changes have necessarily resulted in the formulas for these preparations. In brown mixture, syrup and mucilage of acacia are now directed in place of sugar and powdered acacia. We can see no advantage from the change.

The marked changes made in the formula for Mistura Rhei et Sodæ are such that we cannot approve. To make this formula conform strictly to the newly adopted idea of a mixture, 35 per cent. by volume of glycerin is introduced. But why has ipecac been added to the formula? It is to be observed, that the amount of ipecac is one-fifth that of the rhubarb; now one grain of ipecac is quite as active comparatively as the five grains of rhubarb, and this if desirable to be introduced should be indicated in the title.

Oleate of Mercury now is made by dissolving 20 parts of yellow oxide of mercury in 80 parts oleic acid. The 20 per cent. oleate will be found more permanent than the 10 per cent. of 1880. The red mercuric oxide finely powdered and dried answers as well as the yellow oxide. This formula, however, still leaves a decided excess of oleic acid not in combination. The true oleate prepared by double decomposition (and containing but a very small amount of free oleic acid due to acidity of the metallic nitrate solution used) should have been introduced. Oleate of zinc of the Pharmacopœia is likewise a solution of 5 per cent. of the oxide in oleic acid. It

forms a hard, unctuous mass. This should have been the impalpable powder obtained by precipitation from solutions of alkaline oleate and zinc sulphate. Almost all the zinc oleate of commerce is the latter.

The entire class of oleoresins is directed to be prepared by exhausting the powdered drug with ether (stronger ether of U. S. P. 1880). The complete exhaustion of the drug directed is wasteful of the ether, as experiments have shown that it is not advantageous to continue the percolation beyond that point necessary to obtain 150 to 200 cc. of percolate for every 100 gm. of the drug. The small amount of oleoresin yielded by continuing the percolation till the drug is completely exhausted will not pay for the ether lost. For some of these oleoresins a cheaper solvent would have been acetone. (See Amer. Journal of Pharmacy, 1892, 145.)

In the statements regarding the characters and properties of both the fixed and volatile oils we notice a decided improvement. Many of the errors in the Pharmacopœia, 1880, in stating the physical properties of the essential oils are corrected.

It is to be noted that in the Expressed Oil of Almond the solubility of the separated fat acids in alcohol is adopted to detect the admixture of other fixed oils, and in lard oil and olive oil the reduction of silver nitrate in acidified alcoholic solution is applied for the detection of cotton-seed oil. The iodine absorption test of Hübl is generally accepted by chemists as a valuable test for adulterants in these oils. It has nowhere, in the volume, been directed, probably because it was thought too difficult for the average pharmacist. Yet the only apparatus it requires, a burette and a bottle or a beaker should be in every pharmacy. In marked contrast to this, we note that in a number of the essential oils the optical rotary values are given and on p. 512, we find instructions for determining the same. The polariscopic apparatus needed is not in the possession of the pharmacist. In many cases, the natural variations of the oils in the optical behavior and the causes affecting the same are still to be further investigated.

The Oil of Bitter Almond should have been "sine prussic acid" or if that was deemed unnecessary, at least the percentage of hydrocyanic acid allowable should have been stated. The test for synthetic oil, by detecting chlorinated compounds has proven very satisfactory in the writer's experience.

[*To be continued.*]

ROSE CULTURE IN BULGARIA.

From the World's Fair Circular of Shipkoff & Co., Kizanlik.

The culture of roses in Bulgaria for the purpose of extracting the Otto of Rose is not only the oldest and most attractive industry of the country but also quite exclusively our own. While roses are found all over the world and are grown everywhere in garden-beds, in Bulgaria they are grown in extensive fields, as you grow here the potato or the vine. This industry, however, is confined only to one special district in Bulgaria, which is comprised in the eight counties above mentioned, with Kizanlik as their central town, called in consequence the capital of the rose district. The rose district extends along that portion of the southern slopes of the Balkan Mountains, comprising in itself the whole branch range of the Little Balkans, which shoots out of the main Balkans and forms one of its chief arms. The average length of the rose district is about eighty miles, and its average width is about thirty miles. Its average elevation is about 1,300 feet above the level of the sea. The average height of the Balkans along the rose district is about 5,600 feet, while that of the Little Balkans is about 3,700 feet.

Attempts have often been made to grow roses all over Bulgaria but they all have proved a failure. It is true that roses have been grown and are grown to this day in Persia, India, Egypt and China for this purpose, but they hardly produce any Otto of Rose. They produce almost exclusively rosewater, and it is chiefly used for local consumption. In the "Maritime Alps" of Southern France, and especially in Cannes and Grasse they grow quite extensively the "Provence rose," and they extract from it a peculiar Otto of Rose, but the quantity is very limited and they chiefly use their flowers to make pomades and rosewater. In Leipzig, Germany, they also grow the roses but with very little success. Almost in all the other places where the roses are grown, they lack the peculiar advantages of climate that we possess, and have in consequence to use twice and even thrice the quantity of flowers to make the same amount of Otto. The hottest weather we ever experience in summer is 88° F. and the coldest of winter is rarely under 15° F. above zero. Then, during the harvest and the distillation season, which is in the latter part of May and the first part of June, we have regular showers of rain, and in the mornings heavy falls of dew—both absolutely necessary for the Otto of Rose distillation.

After the Russo-Turkish war in 1877–78, when Bulgaria was separated from Turkey and constituted into an independent principality, the Turkish government spent thousands of dollars in trying to replant the Kizanlik rose in Asia Minor and many scores of rose gardens were planted around Broussa, but to no purpose. The gardens grew, thrived and yielded plenty of flowers, but when distilled they got only rosewater, and very little Otto, and the work in consequence, could not pay. It is the peculiarity of the soil and chiefly that of the atmosphere of this special district in Bulgaria, caused by the peculiar formation of the mountain ranges surrounding it, which make the roses thrive and yield sufficient Otto of Rose to pay for the very laborious work that the culture entails.

The roses we grow are only of two kinds: red and white. The red rose, which affords the chief ingredient of the Otto, is of the variety known as *Rosa Damascena*, and the white rose, is a variety of the musk rose (*Rosa Muschatta*). These two varieties are grown nearly everywhere, but nowhere in the world do they resemble our roses.

Our red rose is a semi-double light red rose like the French *rose du roi*, having from thirty to thirty-six petals and possessing an extremely rich and fragrant odor. There are now in the entire rose district over 5,500 acres of rose gardens scattered in 150 different villages, and at the end of May, when the roses begin to blossom, the whole atmosphere in the district is full of their aroma.

The growing of the rose is very much like the growth of the vine, and the planting of a rose garden is similar to that of a vineyard. After the ground has been prepared by tilling and manuring, ditches are made in rows, about a foot and a half in depth and width and a yard and a half apart. At the bottom of these ditches soft earth mixed with manure is spread, on which the roots forming the bushes of the new rose garden and taken from old bushes are firmly stuck vertically, and then well covered up with the earth and manure. This is generally done in the spring, when the rain showers abound. The roses thus planted soon take root, and in less than two months send up soft, glossy, green shoots, which in a year become about a foot high. In the second year they are over two feet high, and yield a few rose flowers. The first crop worth gathering is in the third year, and in the fifth year they attain their full growth. They

reach then a height of about six feet, the bushes forming thick rows of clustered rose trees and continuing to yield rich crops of flowers for a period of twenty years, and in some localities, twenty-five years, after the lapse of which time they become old, begin to die from the winter's cold and frost, and yield but few flowers. Then the old rose bushes are dug out and the garden is planted anew.

A rose garden requires constant care. During the year it is hoed three times. In autumn the roots are covered up with earth to guard them from the winter's cold. In spring that earth is thrown off and the bushes are pruned, and every other year the garden is manured.

The roses yield only one crop every year. The rose harvest begins in the second part of May, and as the weather is dry and hot or cool and rainy during the blossoming season, it may last from eighteen to thirty days. During the whole harvest the distillation of the crop is carried on. Morning after morning, hours before sunrise groups of young maidens and boys, all dressed in their beautiful bright-colored native costumes, proceed with sweet songs to the rose gardens to gather the newly opened buds, while the heavy morning dew is still on the blossoms. Nothing can present a more captivating scene than a rose garden in bloom, with its gaily attired peasant girls gathering the roses, and its nightingales—those romantic lovers of the *Regina florum*—trying in most melodious song to outsing the maidens.

As soon as the roses are gathered they are taken to the distillery, spread in cool and shady rooms and gradually distilled during the day. The alembics used for this purpose are of the simplest kind. They consist of a convex tinned copper boiler, narrowed at the top to a neck on which is fixed a spherical head-piece with a tube on one side, to which is attached the condensing tube, sloping down and passing through the condenser or refrigerator, a large vessel into which cold water is constantly running. The capacity of the boiler is about 250 pounds of water. In distilling the roses from twenty to twenty-five pounds of flowers are put in it and from five to six times that much of water, thus filling nearly three-fourths of the boiler. This done the headpiece and condensing tube are tightly attached, the fire started and the distilling of its contents begun. This is carried on about forty-five minutes until thirty to thirty-five pounds of rosewater are extracted from each boiler. The boilers

are then emptied, cleansed with clear water and the same process is repeated until all the morning gathered flowers are distilled. The rose-water extracted from the first distillation is redistilled in the same way, only in this second distillation from 100 to 120 pounds of rose-water is used, and out of it they extract some thirty to thirty-five pounds of second rosewater. This double distilled rosewater is very strong in odor and quite turbid in appearance; it is full of tiny yellow-white oily globules floating in it, and as the bottle is filled they rise up and gather on the top of the long-necked bottles in which the rosewater runs. These globules are the Otto of Rose, and when all the oil has settled on the tops of the bottles it is skimmed and put in separate bottles by little conic-like spoons, with a little hole in the bottom, large enough to let the water run out, but not the oil.

There are at present about 5,500 acres of rose gardens in the entire rose district, which produce annually from 17,000,000 to 21,000,000 pounds of flowers, or about 5,400,000,000 roses. A rose garden, an acre large, yields under the most favorable circumstances from 4,000 to 4,500 pounds of roses, out of which amount is extracted from twenty to twenty-five ounces of Otto of Rose. It takes generally from 180 to 220 pounds of roses to make one ounce of Otto of Rose, and there are about 300 roses to the pound. The total amount of Otto of Rose produced annually in the whole district varies according to the seasons, from 60,000 to 100,000 ounces of Otto of Rose. Last year the whole crop amounted to about 60,000 ounces, while this year the crop will not exceed the total sum of 80,000 ounces. Nothing can be positively known of the yield of a crop before it has been fully distilled. Many things damage a crop, as hailstorms in autumn, excessive cold in winter, early and deceptive spring, white frost during the budding season, and hot and dry weather during the harvest. The last two cause the greatest damage to a crop.

Nearly all the Otto of Rose produced in Bulgaria is exported for consumption abroad. Its three largest markets are Paris, London and New York, from where it is distributed all over the world. All the principal perfumers procure now their supply direct from the native manufacturers and exporters.

MINUTES OF THE PHARMACEUTICAL MEETING.

PHILADELPHIA, November 21, 1893.

The meeting was called to order and Jos. W. England was asked to preside.

The reading of the minutes of the last meeting was, on motion, dispensed with, as there was a great deal to hear and act on.

A copy of the last edition of the German Pharmacopœia was presented to the library by Geo. M. Beringer, Ph.G., and a copy of Nicholas Le Febures' complete body of chemistry was presented by our fellow-member, F. H. Rosengarten, who received it from the late E. C. Knight, of this city, who placed much value on it, as it dated as far back as 1670, and abounds in many original statements.

A paper upon the effects of noxious gases upon the animal economy, by Mr. J. R. Wilson, was read by Dr. C. B. Lowe, Mr. Wilson being too unwell from a severe cold to read it himself. The paper was listened to with great attention, and was referred to the Committee on Publication, and a vote of thanks was tendered to Mr. Wilson.

Mr. Charles E. Hires read a paper upon Vanilla, its sources, cultivation, methods of preparing for the market, commercial statistics relative to it, the whole being the result of a visit made to the country from which the largest part of the Vanilla supply of commerce is derived. The trip may be called an adventure, as the country is inhabited by as lawless a race as can be found anywhere; to this must be added the danger of contracting that terrible scourge of the tropics—yellow fever. On motion of Mr. Beringer, a vote of thanks was passed to Mr. Hires for his interesting paper.

The third paper, upon the examination of various commercial samples of wax, was read by Lyman F. Kebler, Ph.C., B.S. It was listened to very attentively, and was one of the best and most thorough examinations that has been given to the subject. It was also referred, after which the meeting passed a vote of thanks to the author. Mr. Beringer exhibited a sample of Carnauba wax, a drug of Brazilian origin, which melts at quite a high temperature.

Mr. Allen Shryock read a paper upon the weights of the Pharmacopœia of 1890, and urged the use of the decimal WEIGHTS and not any equivalents obtained by calculating how many troy or avoirdupois grains would give an equal quantity. This paper was also referred to the Publication Committee.

Mr. Ellis inquired if the artificial product Vanillin has affected the sale of Vanilla, to which answer was made it had not; that it did not represent Vanilla bean flavor as it should; it bears about the same relation to Vanilla bean in flavor as the ethereal fruit essences do to the real fruit juices.

G. M. Beringer called the attention of the meeting to one of the newer remedies, Ethylene Bromide, $C_2H_4Br_2$. Viewed as an addition product of Ethylene C_2H_4, this would be the correct name, and was the one generally used in prescribing; but viewed as a substitution product of ethane C_2H_6, it was Di-Brom-Ethane. This is now being recommended as an anti-epileptic, in doses of 0·1–0·3 gm., 2 or 3 times a day, and may be administered in capsules or emulsion. As supplied by the German manufacturers, it is a slightly brownish colored liquid, due to traces of bromine, sp. gr. 2·163 at 21° C., crystallizing at 10° C. He exhibited a sample which had been redistilled by Mr. Chas.

Bullock. About 20 per cent. of the commercial product distilled below the boiling point, showing that it was far from pure. The purified article was a heavy colorless liquid, sp. gr. 2·166, having a pleasant, almost chloroformic odor boiling at 127° C. (260° F.) and leaving a greasy stain on paper persisting for some little time. It was soluble in alcohol, but insoluble in water. In large doses it is said to be poisonous.

It was suggested that as the meetings were growing in interest, that it would be better to commence at three o'clock, and it was so determined.

T. S. WIEGAND.

PHARMACEUTICAL COLLEGES AND ASSOCIATIONS.

Pennsylvania Pharmacy Board.—The State Pharmaceutical Examining Board of Pennsylvania held an examination in the Central High School at Philadelphia, on Saturday, October 14, and in the City Council Chambers at Pittsburg on Monday, October 16, 1893.

Two hundred and seventy-three candidates appeared for examination, one hundred and forty-seven applying for Registered Pharmacists Certificates, and one hundred and twenty-six for Qualified Assistants Certificates. Forty-five of the former and fifty-two of the latter class were successful.

The next examination will be held at Philadelphia in January. Applicants for examination should apply to the Secretary of the Board, Charles T. George, Harrisburg, Pa., after the middle of December, for the necessary blank form of application, and the exact time and place of the examination. Applicants should always state, when applying for blanks, for which certificate they wish to be examined.

EDITORIAL.

Prof. Edson S. Bastin, A.M., successor to the late Prof. John M. Maisch, took charge of his department at the beginning of November and was tendered a reception by the Board of Trustees on Saturday evening, November 18, at 8 o'clock. Following the reception, Dr. Charles L. Mitchell, Class of 1872, exhibited stereopticon views illustrating a summer tour in Europe. Quite a large number of members and graduates of the College were present to welcome Professor Bastin to the faculty.

Professor Bastin came to our Alma Mater from Chicago, where he had been successfully imparting his knowledge both at the Chicago and then at the Illinois College of Pharmacy and will continue his successful teaching here in Philadelphia. The Board of Trustees can be congratulated in selecting Professor Bastin to be successor to the late Professor Maisch, as he is an able and conscientious teacher and will also be well thought of by the students. As the writer gained from several conversations with the late Professor Maisch, he had a high regard for Professor Bastin, both for his teaching and his knowledge.

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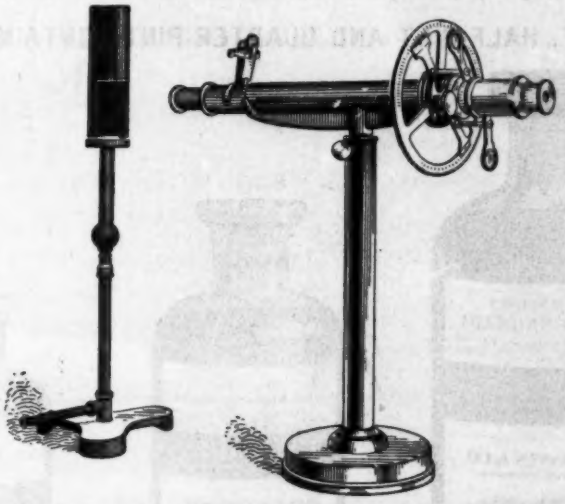

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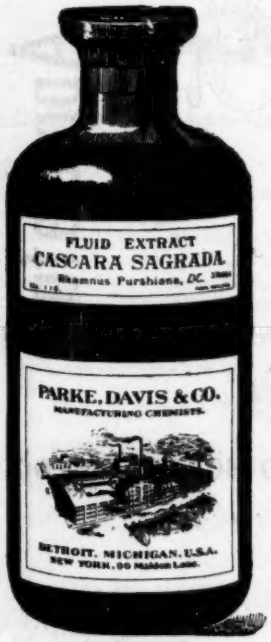

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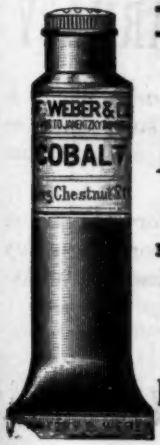

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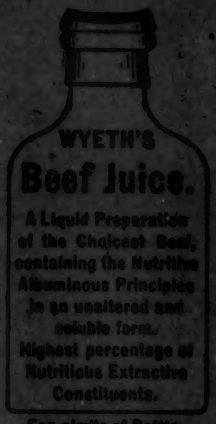
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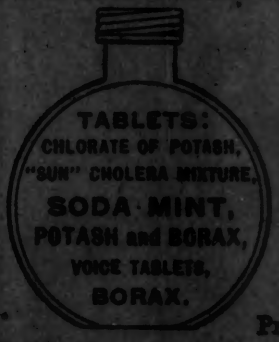

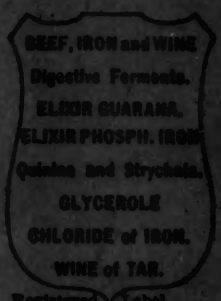

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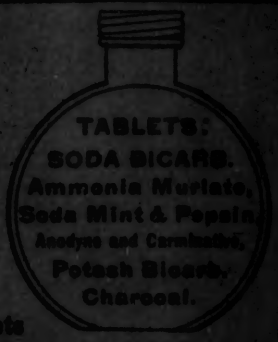

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